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Jet Propulsion Laboratory
California Institute of Technology
Pasadena, California


Cloud Computing @ JPL Science Data Systems

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Outline


- Science Data Systems (SDS)
- Space & Earth SDSs
- SDS Common Components
- Components using Cloud Computing
- Use Case 1: LMMP
- Use Case 2: ACCE
- Strategy

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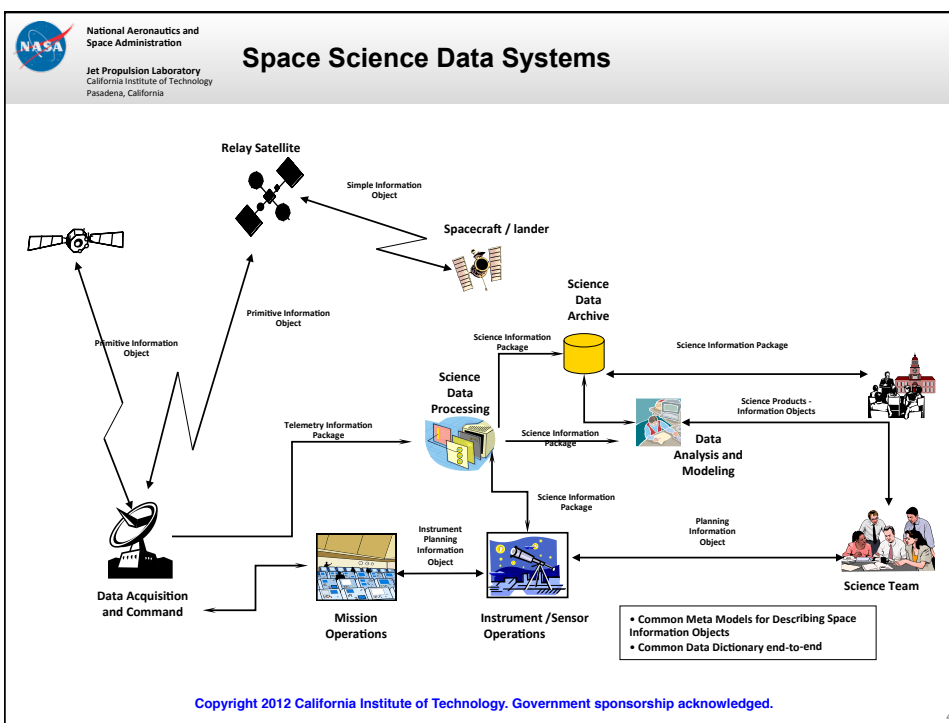
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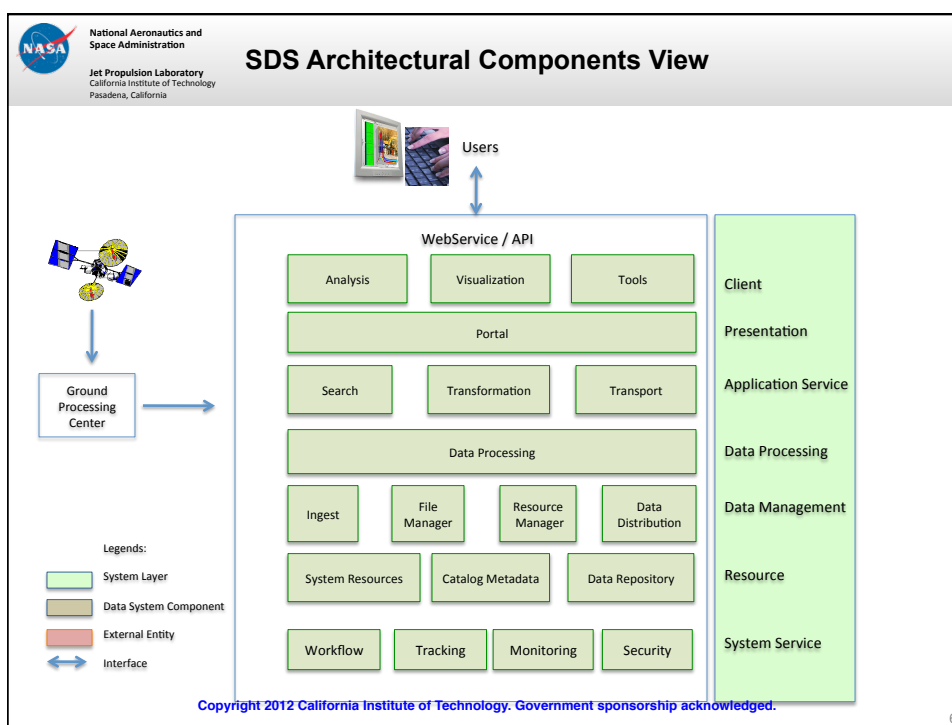
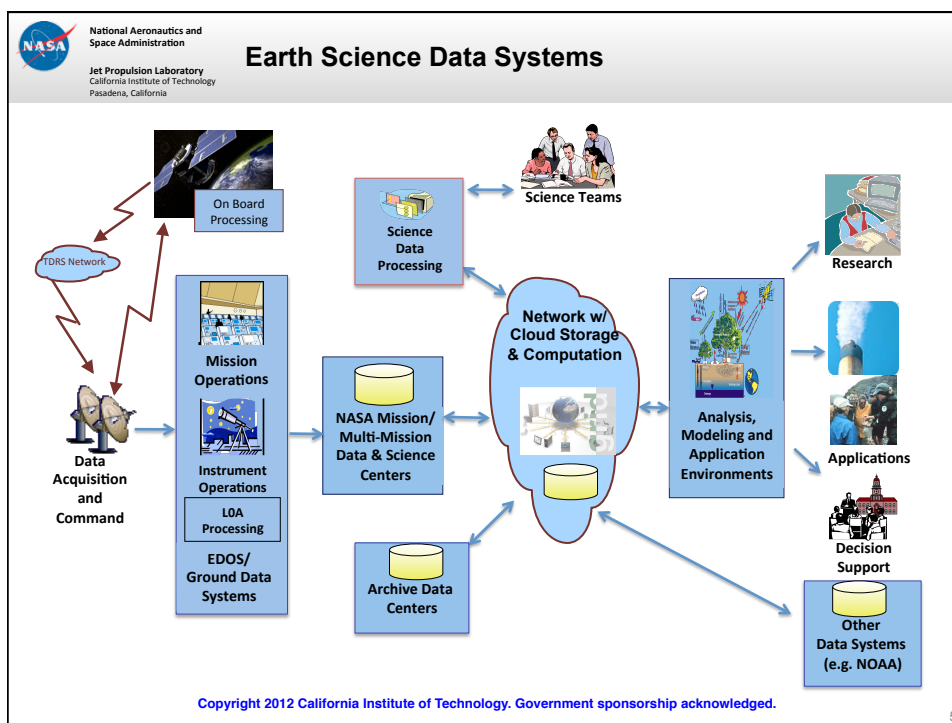
Science Data Systems (SDS)

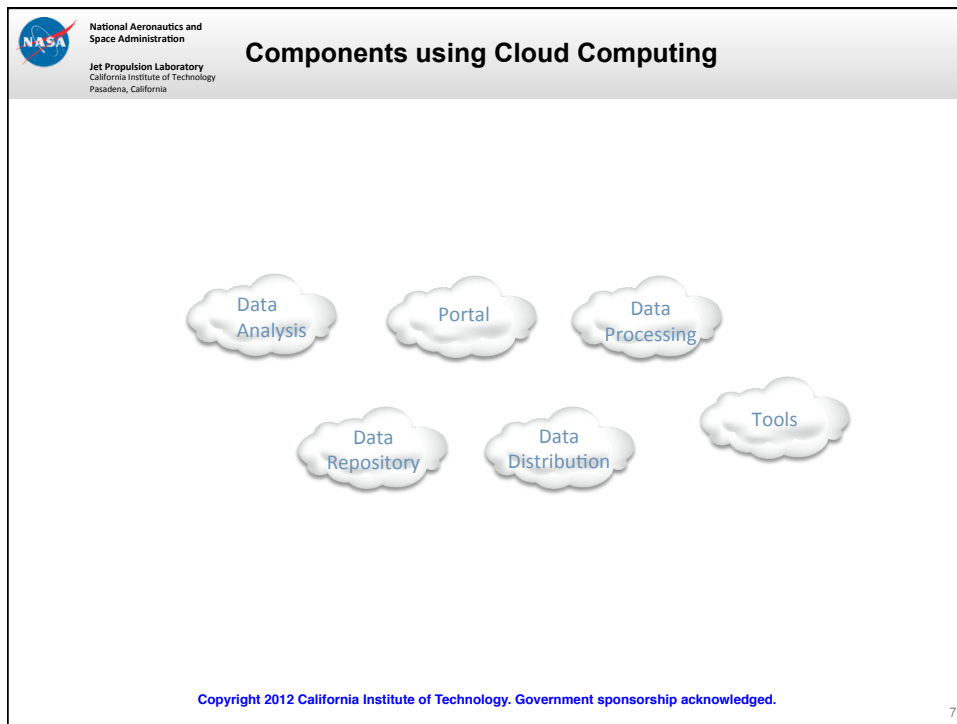
- Cover a wide variety of domain disciplines
 - Solar system exploration, Astrophysics, Earth science, Biomedicine, etc,...
- Each has its own communities, standards and systems
- But, there is a set of common components
- Some can greatly benefit from proven cloud computing technologies



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Use Case 1: Lunar Mapping & Modeling Project (LMMP)

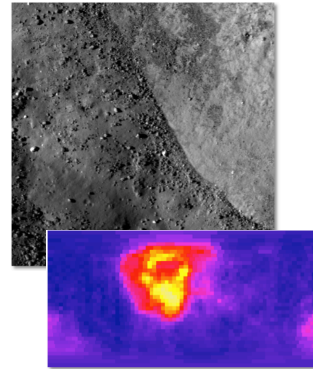
- Provide science and exploration community a suite of lunar mapping and modeling tools and products that support the lunar exploration activities
- The tools and products are made available through a common, intuitive NASA portal
- Publicly available since March 2012
- <http://lmp.nasa.gov>

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Challenge

- The image files LMMP manages range from a few gigabytes to hundreds of gigabytes in size with new data arriving every day
- Lunar surface images are too large to efficiently load and manipulate in memory
- LMMP must make the data readily available in a timely manner for users to view and analyze
- LMMP needs to accommodate large numbers of users with minimal latency

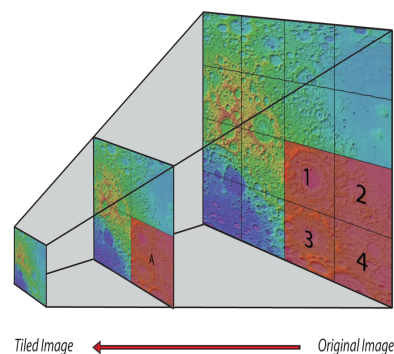


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Cloud Computing Solutions

- Slice a large image into many small images and to merge and resize until the last merge and reduce yields a reasonably sized image that depicts the entire image
- Amazon E2C/S3
- Used distributed approach with Elastic MapReduce to tile images
- Developed a hybrid solution (multi-tiered data access approach) to serve images to users by cloud storage



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Findings

- **Computing performance**
 - Comparable especially for the new machines with significant processing capability
 - EC2's "rental" model offers better performance per dollar than having to purchase and maintain local servers
- **Storage**
 - Pay for just the bandwidth consumed
 - Eliminate the need to purchase extra hardware and bandwidth to handle the occasional spikes in usage
- **Cloud Deployment**
 - Increase latency
 - Enable fault tolerance

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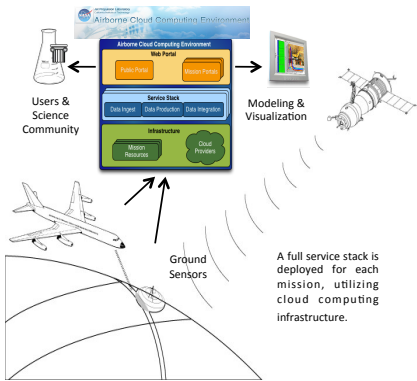


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Use Case 2: Airborne Cloud Computing Environment (ACCE)


- Multi-mission capability providing distributed SDS services applicable to space-borne missions
 - File Management
 - Workflow Management
 - Resource Management
- Extend the existing services to utilize cloud services, commercial, community and private
 - Storage
 - Compute Resources



A full service stack is deployed for each mission, utilizing cloud computing infrastructure.

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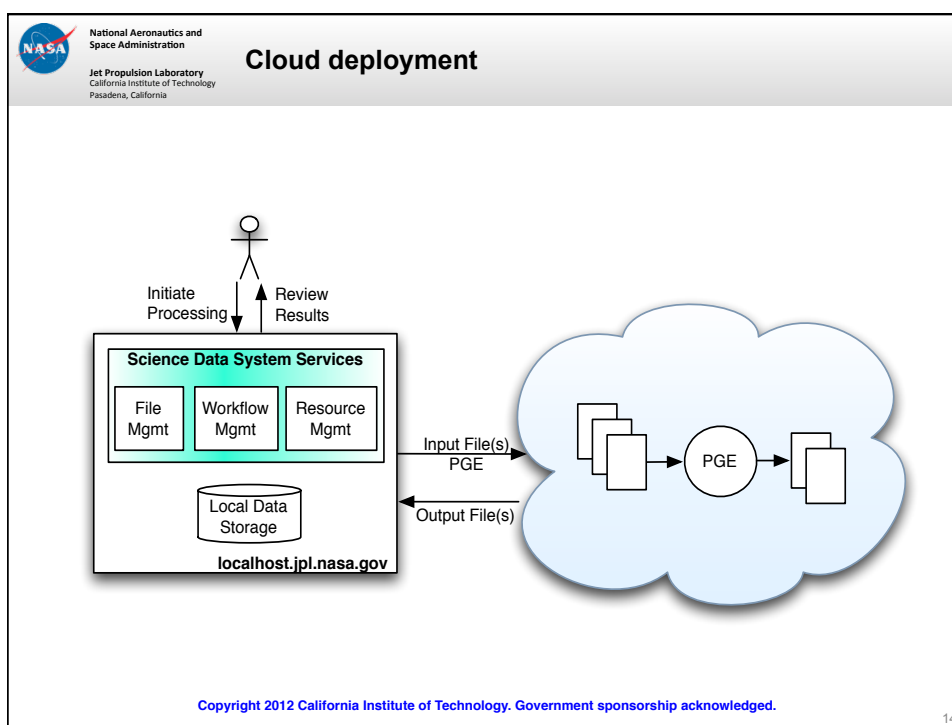
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Approach

- Explore the benefits of performing science data processing for airborne missions in the cloud
- Evaluate different cloud technologies
 - Amazon EC2/S3
 - Elastic compute resources and on-demand storage
 - Eucalyptus
 - Infrastructure software for establishing a private cloud
 - Hadoop – Distributed File System (DFS) and MapReduce
 - Increased processing performance on large data sets

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Findings

- Processing cost reduction
 - No investment in capital required (upfront or refresh costs)
 - Pay only for what you use
- Challenge
 - Host Environment
 - Support for ITAR-sensitive data
 - Data transfer rates between JPL and commercial cloud
 - JPL Firewall

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Take Away

- Many benefits
 - Accessible from anywhere
 - Increase/decrease number of machines based on user defined parameters
 - Resizable compute capacity for unlimited growth
 - Utility Computing, pay by the drink, rapidly provisioned
- But....
 - Complexity
 - Security
 - Reliability
 - Feasibility
 - Standards

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Strategy

- Cloud computing is an approach and tool to support “Big Data”
- Cloud Computing Working Groups
 - Common architecture
 - Common cloud framework
 - Lessons Learned
 - Best Practices
- Further benchmarking, optimization, research
- Collaboration

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Thank You

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